WE CLAIM:

1. A gradient search algorithm for a speech coding system, comprising calculating a gradient vector; and calculating a contribution to said gradient vector in response to variations in decomposition coefficients.

2. The gradient search algorithm according to Claim 1, used in combination with finding roots of a speech synthesis polynomial, wherein said gradient search algorithm further comprises iteratively calculating said gradient vector and recalculating said contribution at each iteration, whereby said decomposition coefficients vary between iterations.

3. The gradient search algorithm according to Claim 2, wherein one of said decomposition coefficients corresponds to each of a plurality of said roots.

4. The gradient search algorithm according to Claim 3, wherein said gradient vector and said contribution to said gradient vector are calculated using the formula:

$$(k)/\ \lambda_r^{(j)} = \sum_{m=0}^{k} u(k-m) \sum_{i=1}^{i=M} b_i K(i,r)(\lambda_i^{(j)})^{(m-1)} + b_r \sum_{m=1}^{k} mu(k-m)(\lambda_r^{(j)})^{(m-1)}\ (k\quad 0).$$

5. The gradient search algorithm according to Claim 1, used in combination with a speech coding system for encoding original speech, the speech coding system comprising an excitation module responsive to an original speech sample and generating an excitation function; a synthesis filter responsive to said excitation function and said original speech sample and generating a synthesized speech sample; and a synthesis filter optimizer responsive to said excitation function and said synthesis filter and generating an optimized synthesized speech sample; wherein said synthesis filter optimizer minimizes a synthesis error between said original speech sample and said synthesized speech sample; wherein the gradient search algorithm is used by said synthesis filter optimizer.

6. The gradient search algorithm according to Claim 5, wherein said synthesis filter optimizer comprises a root optimization algorithm, thereby making possible said minimization of said synthesis error; wherein said synthesis filter comprises a predictive coding technique producing said synthesized speech sample from said original speech sample; wherein said predictive coding technique produces first coefficients of a polynomial; wherein said root optimization algorithm is an iterative algorithm using first roots derived from said first coefficients in a first iteration; and wherein said root optimization algorithm produces second roots using the gradient search algorithm in successive iterations resulting in a reduction of said synthesis error in said successive iterations.

7. The gradient search algorithm according to Claim 6, wherein the gradient search algorithm further comprises iteratively calculating said gradient vector and recalculating said contribution at each iteration, whereby said decomposition coefficients vary between iterations, and wherein one of said decomposition coefficients corresponds to each of a plurality of said roots.

8. The gradient search algorithm according to Claim 7, wherein said gradient vector and said contribution to said gradient vector are calculated using the formula:

$$(k)/\ \lambda_r^{(j)} = \sum_{m=0}^{k} u(k-m) \sum_{i=1}^{i=M} b_i K(i,r)(\lambda_i^{(j)})^{(m-1)} + b_r \sum_{m=1}^{k} m u(k-m)(\lambda_r^{(j)})^{(m-1)}\ (k\quad 0).$$

9. A gradient search algorithm for a speech coding system, comprising calculating decomposition coefficients; calculating a first gradient of a polynomial using said decomposition coefficients; estimating roots of said polynomial using said first gradient; recalculating said decomposition coefficients based on said estimating; calculating a second gradient of said polynomial using said recalculated decomposition coefficients; and estimating said roots of said polynomial using said second gradient.

10. The gradient search algorithm according to Claim 9, wherein said gradient and said decomposition coefficients are calculated using the formulas:

$$(k)/\ \lambda_r^{(j)} = \sum_{m=0}^{k} u(k\text{-}m) \sum_{i=1}^{i=M} b_i K(i,r)(\lambda_i^{(j)})^{(m-1)} + b_r \sum_{m=1}^{k} mu(k\text{-}m)(\lambda_r^{(j)})^{(m-1)}\ (k\ \ 0)$$

$$b_i = \prod_{j=1,\ j\neq i}^{M} [1/(1-\lambda_j \lambda_i^{-1})].$$

11. The gradient search algorithm according to Claim 9, used in combination with a linear predictive coding speech system.

12. The gradient search algorithm according to Claim 9, used in combination with a method of generating a speech synthesis filter representative of a vocal tract, the method comprising computing a first synthesis error between an original speech and a first synthesized speech sample corresponding to roots estimated with said first gradient; and computing a second synthesis error between said original speech and a second synthesized speech corresponding to roots estimated with said second gradient; wherein said second synthesis error is less than said first synthesis error.

13. The gradient search algorithm according to Claim 12, wherein said gradient and said decomposition coefficients are calculated using the formulas:

$$(k)/\ \lambda_r^{(j)} = \sum_{m=0}^{k} u(k\text{-}m) \sum_{i=1}^{i=M} b_i K(i,r)(\lambda_i^{(j)})^{(m-1)} + b_r \sum_{m=1}^{k} mu(k\text{-}m)(\lambda_r^{(j)})^{(m-1)}\ (k\ \ 0)$$

$$b_i = \prod_{j=1,\ j\neq i}^{M} [1/(1-\lambda_j \lambda_i^{-1})].$$

14. A gradient search algorithm for a speech coding system, comprising means for calculating decomposition coefficients of a speech synthesis polynomial; means for calculating first roots of said polynomial using

said decomposition coefficients; means for recalculating said decomposition coefficients based on said first roots; and means for calculating second roots of said polynomial using said recalculated decomposition coefficients.